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Fabrication of the Appalachian Thinner

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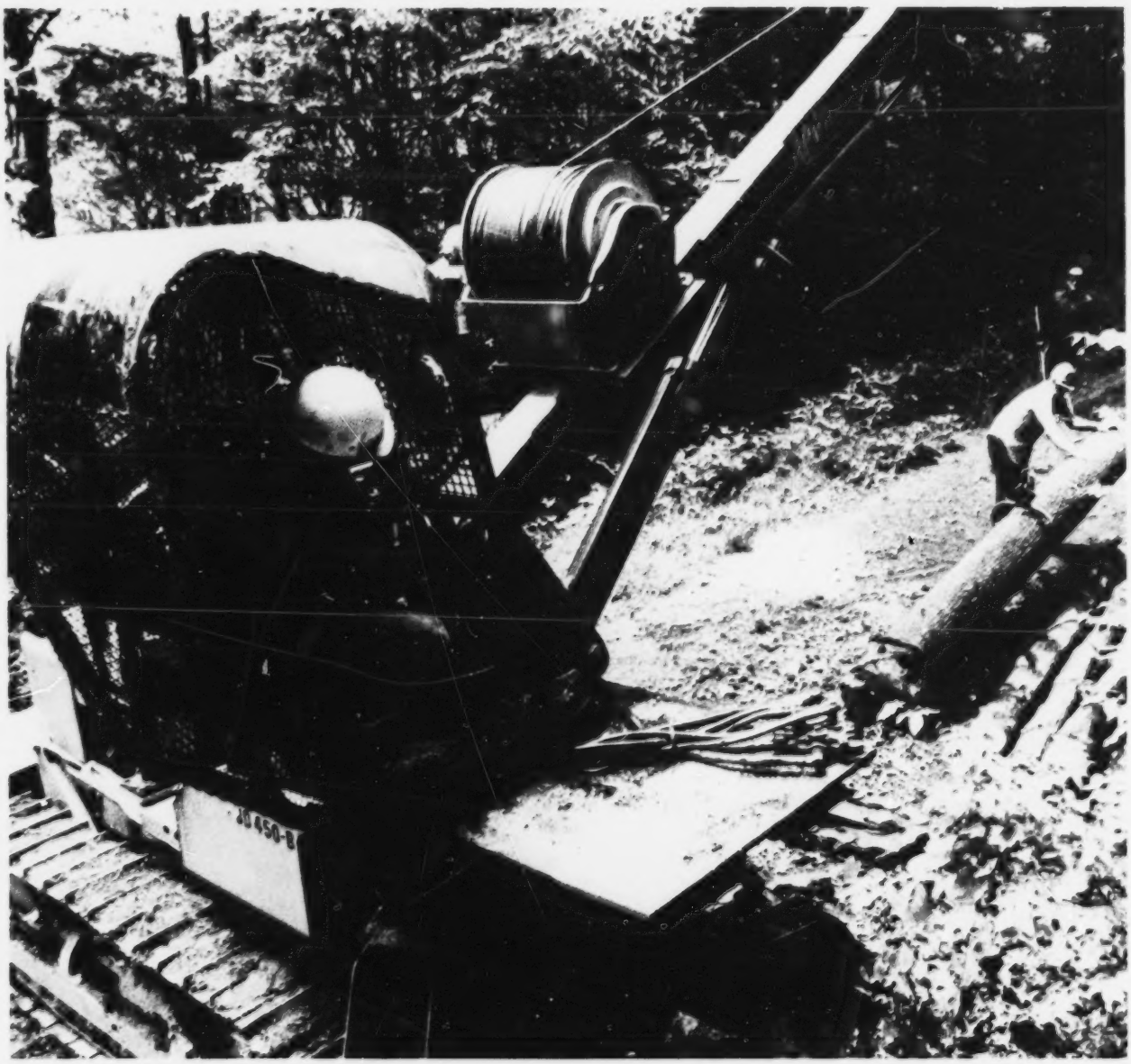

The Author

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Abstract

The Appalachian Thinner, a prototype cable yarder, has proven capable of harvesting timber on steep slopes. Details of the fabrication of the prototype yarder are presented. An Appalachian Thinner can be built economically in a typical logger's repair shop.

Introduction

A hydraulic knuckleboom loader, a hydraulic winch, and a small dozer provided the major components to build a small prototype swing-boom cable logging system called the Appalachian Thinner.

The Appalachian Thinner (Fig. 1) was designed and built by the USDA Forest Service's Engineering Work Unit in Morgantown, West Virginia, to test the concept that a versatile yarder could operate efficiently on small woodland properties. One of the requirements was that the machine be low in initial costs.

Any dozer could serve as a carrier for the thinner, but must have a mounting bracket on the rear so the thinner can be attached. An option on most dozers is the backhoe attachment; when the backhoe is supplied, the dozer comes with a larger hydraulic pump and special mounting brackets. Thus, a dozer that is equipped to take a backhoe is an ideal carrier for the thinner.

Dozer Modifications

The prototype thinner was mounted on a JD-450B crawler tractor.[1] This section records the changes made on the JD-450. Other brands of machines may require different modifications. Each machine should be studied carefully to determine what modifications are necessary to make a good yarder.

[1]The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

Figure 1.—The thinner stacking logs alongside the truck road.

The canopy and winch must be removed from the dozer. The factory canopy is too tall; it will interfere with the swing of the thinner. The winch on the rear of the dozer must be removed so that the thinner mounting bracket can be attached.

We used a JD-450 that had factory-installed backhoe equipment. Thus, the dozer had a flow divider and selector valve in the hydraulic circuit. When the selector valve is in the dozer mode, the flow divider allows only part, 15 gpm max., of the pump flow in the dozer circuit to the blade controls. The balance is returned to the tank. When the selector valve is in the backhoe mode, all flow goes through the backhoe circuit, which we used for the thinner circuit. Thus, the thinner has 23 gpm of hydraulic fluid available from factory-installed equipment on the dozer. A 30 gpm hydraulic pump is added to the thinner and powered by a short drive shaft from the dozer PTO, giving a total flow of 53 gpm.

We wanted the dozer to be usable without the thinner. Therefore, the hydraulic circuits were designed so that fluid would return to operating level in the dozer tank. Using the factory quick disconnects would not allow fluid to return to the dozer tank fast enough, so all fluid used in the thinner is returned to hydraulic tanks on the thinner and flows to the dozer tank by gravity through a 2-inch line. A hole was drilled in the dozer hydraulic tank, and a valve and adapter were attached. Likewise, a hole was drilled in one hydraulic tank on the thinner. These tanks were connected with a 2-inch hose and clamps.

The pressure line from the dozer pump uses the standard backhoe disconnect to supply fluid to the thinner.

An electric throttle was designed for the dozer so that it would not have to be run at high rpm all the time. This throttle has a control box on the dozer and one in the operator's cage on the thinner.

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Loader Modification

A yarder can be made out of any hydraulic knuckleboom loader. The lightest loader that will safely handle the logs should be selected to make the yarder as light and mobile as possible. This section records the modifications made to the Savage Model 100 hydraulic knuckleboom loader[1] (rear mount) to convert it into a yarding attachment (Fig. 2). Twenty inches was cut off the bottom of the support frame to give ground clearance and allow the boom to swing above the dozer operator's seat (Fig. 3). Two smaller hydraulic tanks replaced the original hydraulic tank (Fig. 4) to give clearance for a 30 gpm hydraulic pump. Figure 5 shows the hydraulic tanks, pump, and hoses.

Most hydraulic loaders are not equipped with an operator's cage. One was built for the thinner to protect the operator from broken winch cable (Fig. 6).

The grapple was removed from the loader along with the hydraulic controls. If one were going to load logs with the machine, he might want to consider leaving the grapple on and adding a sheave on top of the boom. The grapple would handle logs on the landing and load trucks faster than the tongs. The design would have to be such that the cable or tongs would not interfere with the hydraulic hoses.

The sheave on the end of the boom needs to be enclosed so the cable cannot slip off the sheave.

At the hinge point in the center of the boom, a roller was added so the cable would have something to move over when the boom is knuckled under (Fig. 7).

A 7/8-inch-thick steel plate was welded to the main boom and reinforced near the operator's cage for mounting the winch. The features of the winch are covered in another section.

The outriggers originally were to be mounted under the support frame of the Savage loader. Since the support frame was shortened, the outriggers had to be mounted at a different location. A mounting bracket was welded on the lower part of the support frame and the outriggers were bolted to it (Fig. 8). When the outriggers are folded, the thinner is 8 feet wide for legal highway travel.

The mechanism that secures the yarder to the dozer is critical. The yarder support frame should be slightly wider than the mounting bracket. A standard John Deere backhoe mount was used; the only modification to the mounting bracket was to enlarge the mounting pin holes to 1-3/4 inches. Figure 8 shows the mounting bracket on the dozer. Figure 9 shows the pin mounts that are fastened to the yarder support frame. It and a piece of steel plate straddled the mounting bracket; the 1-3/4 pin goes through all three pieces. In

(Text continued on page 6)

Figure 2.—Savage Model 100 hydraulic knuckleboom loader.

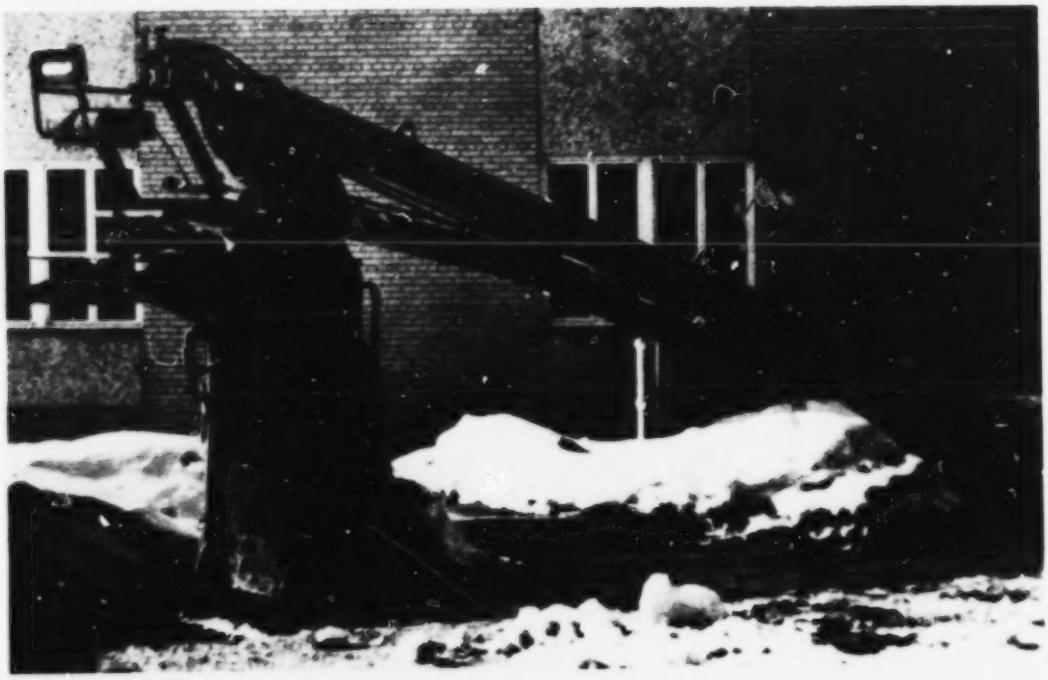

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Figure 3.—Twenty-inch section cut off the bottom of the Savage loader.

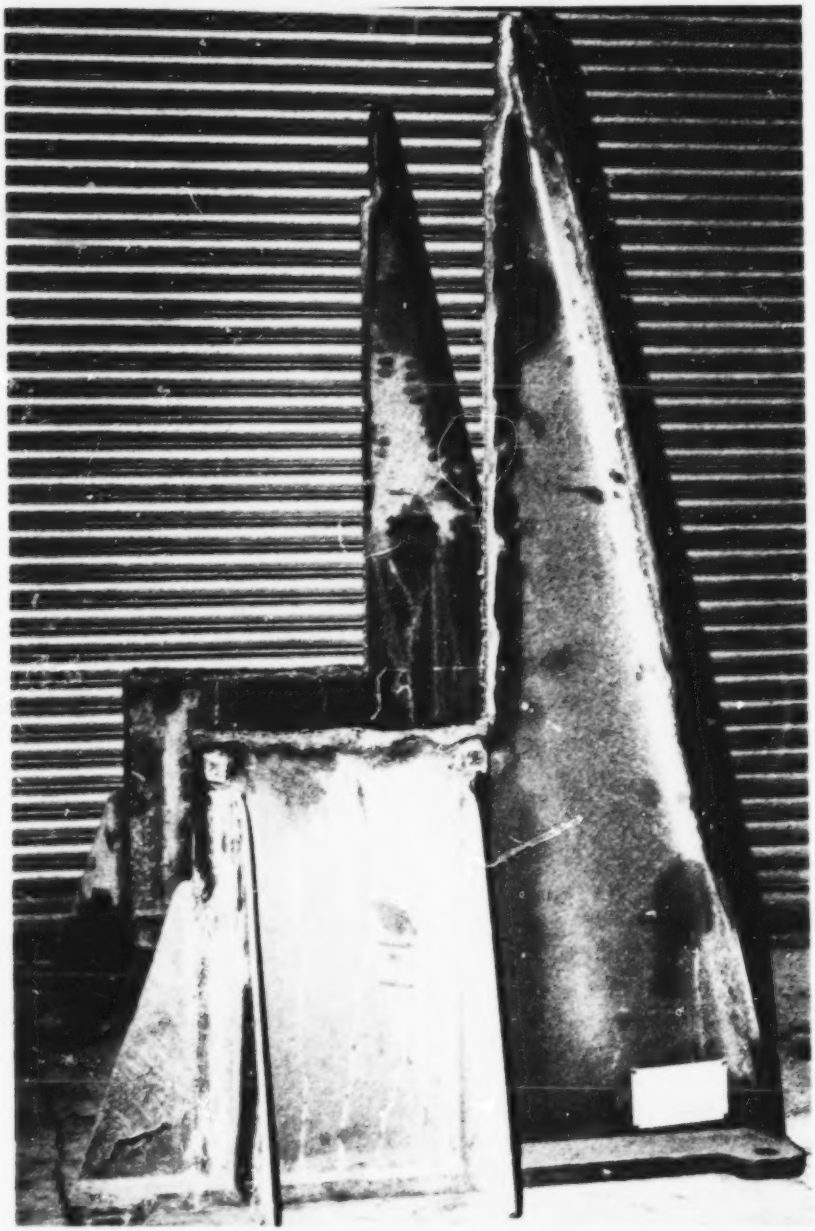

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Figure 4.—Hydraulic tank removed from Savage loader.

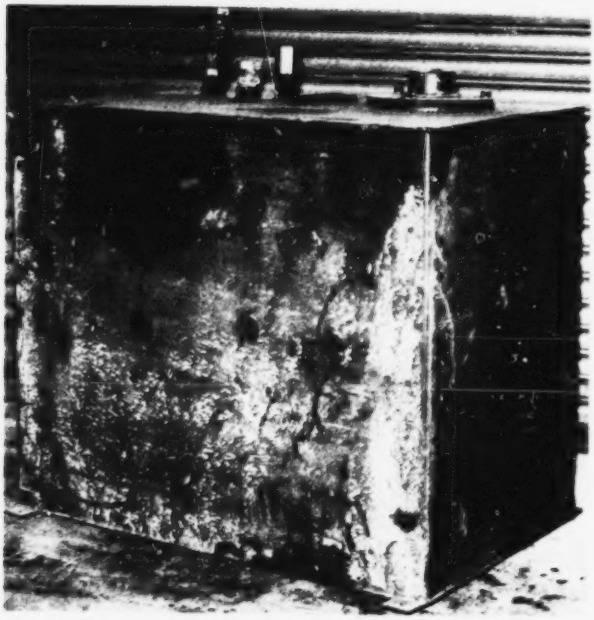

Figure 6.—Operator's cage for protection if cable breaks.

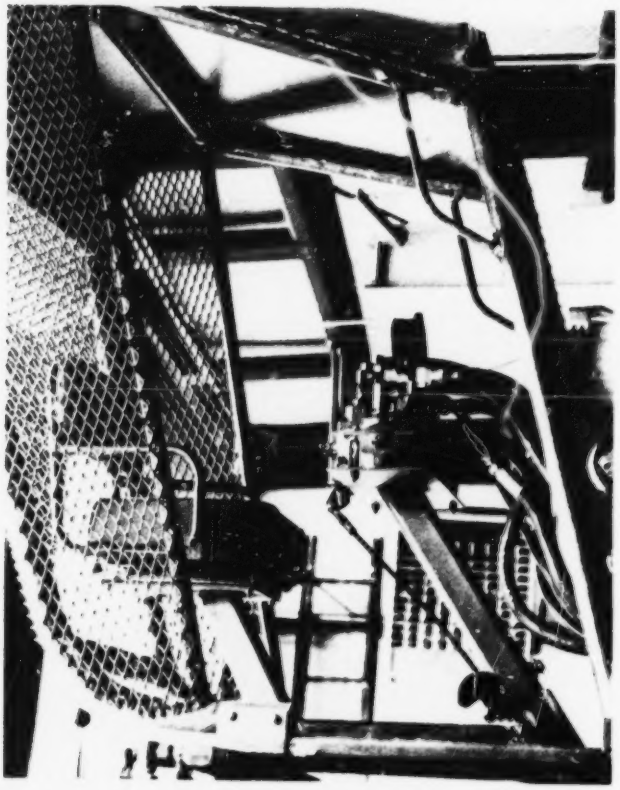

Figure 5.—Thinner's two hydraulic tanks, 30 gpm pump in the center of the two tanks, and return line to the dozer tank.

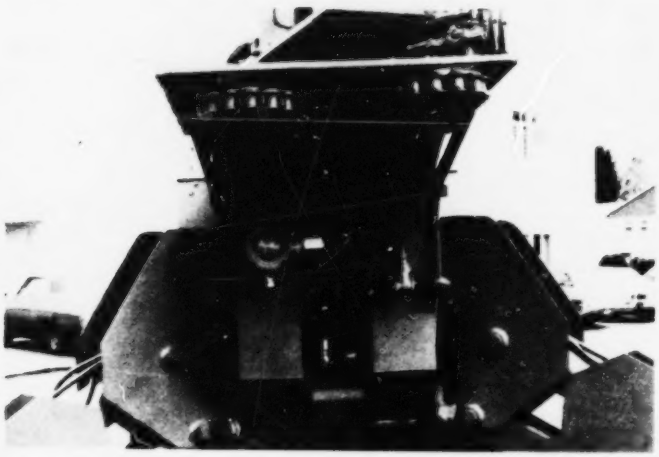

Figure 7.—Thinner placing logs on truck road (Note the roller in the center of the boom).

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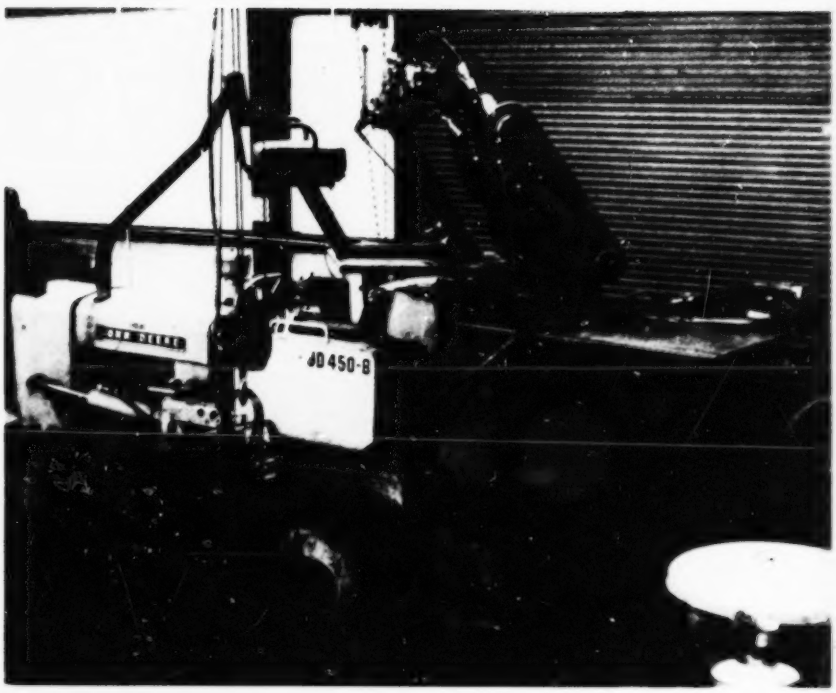

Figure 8.—Loader taken apart and mounted on dozer piece by piece.

Figure 9.—Revised mount of Appalachian Thinner (top mount shown).

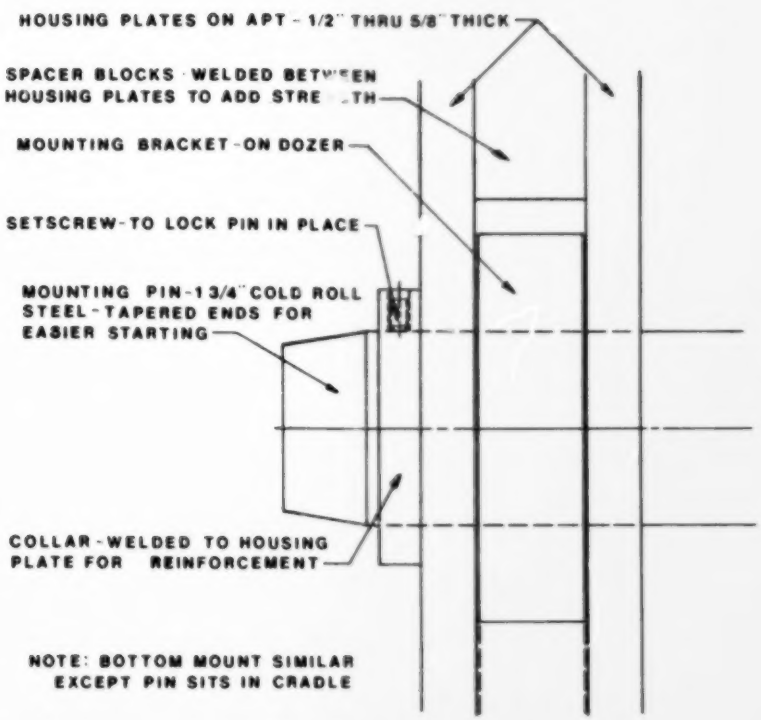
HOUSING PLATES ON APT - 1/2" THRU 5/8" THICK
SPACER BLOCKS WELDED BETWEEN HOUSING PLATES TO ADD STRENGTH
MOUNTING BRACKET-ON DOZER
SETSCREW-TO LOCK PIN IN PLACE
MOUNTING PIN-1 3/4" COLD ROLL STEEL-TAPERED ENDS FOR EASIER STARTING
COLLAR-WELDED TO HOUSING PLATE FOR REINFORCEMENT
NOTE: BOTTOM MOUNT SIMILAR EXCEPT PIN SITS IN CRADLE

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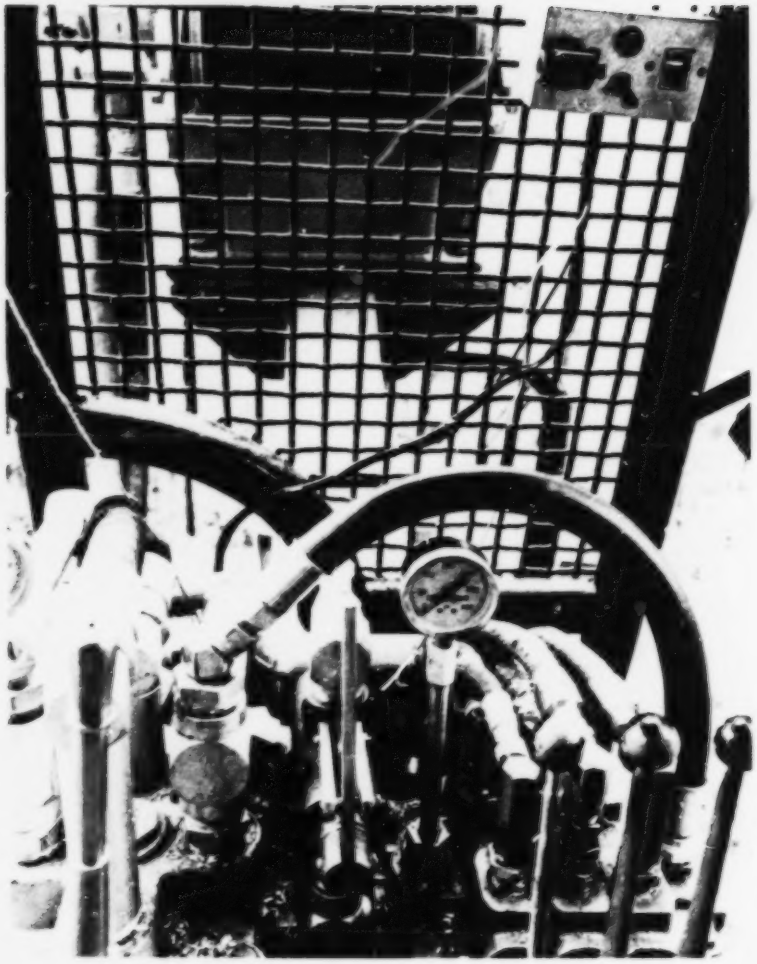
Figure 10.—Yarder controls.



previous design the yarder mount did not straddle the dozer mount, and stress cracks occurred in the yarder mount.

The yarder has to be transported on a lowboy, because even with the cage removed it is 10 feet high, and adding the height of the lowboy approaches the maximum legal road height of 13 feet. Total weight of the prototype including dozer is about 10 tons.

Hydraulic Circuit Modifications

The controls and hydraulic lines for the grapple were removed, but as mentioned earlier, it is possible to leave these on and make the yarder an efficient loader, also. A view of the yarder controls from the operator's cage is shown in Figure 10.

The small box in the upper right corner is the electric throttle control. The three levers on the right control the main boom, jib, boom, and boom rotation. The short lever in the center combines all flow from both pumps to the winch. The long lever on the left is the winch control. The Husco control valve for the winch is open center so that the supply to the winch motor will not cavitate.

The hydraulic circuit for the dozer and the thinner is shown in Figure 11. The selector valve can combine the flow from the pump on the front of the dozer with the flow from the pump on the rear of the dozer and supply this combined flow to the control valve of the winch. When the pump on the front of the dozer is not supplying the winch, it operates the other functions of the yarder.

Hydraulic Winch

The winch mounted on the rear of the main boom is a Gearmatic GH-85. Specifications for the winch are: hydraulic fluid supply—60 gpm at 2500 psi; weight—740 lb; line pull—8570 lb (bare drum), 6089 drum (full drum); line speed—244 fpm (bare drum), 351 fpm (full drum). The winch operates under power in and out, and has a brake applied in neutral.

The pressure relief for the winch is set to release at 8,000 pounds of pull in the winch line. The drum has 1,500 feet of cable on it, and the speed of the cable is near the rated maximum of 351 fpm. The winch has been used to yard logs up to 400 feet. The cable is very high strength Bridon American 3/8-inch cable with a published breaking strength of 18,000 pounds.

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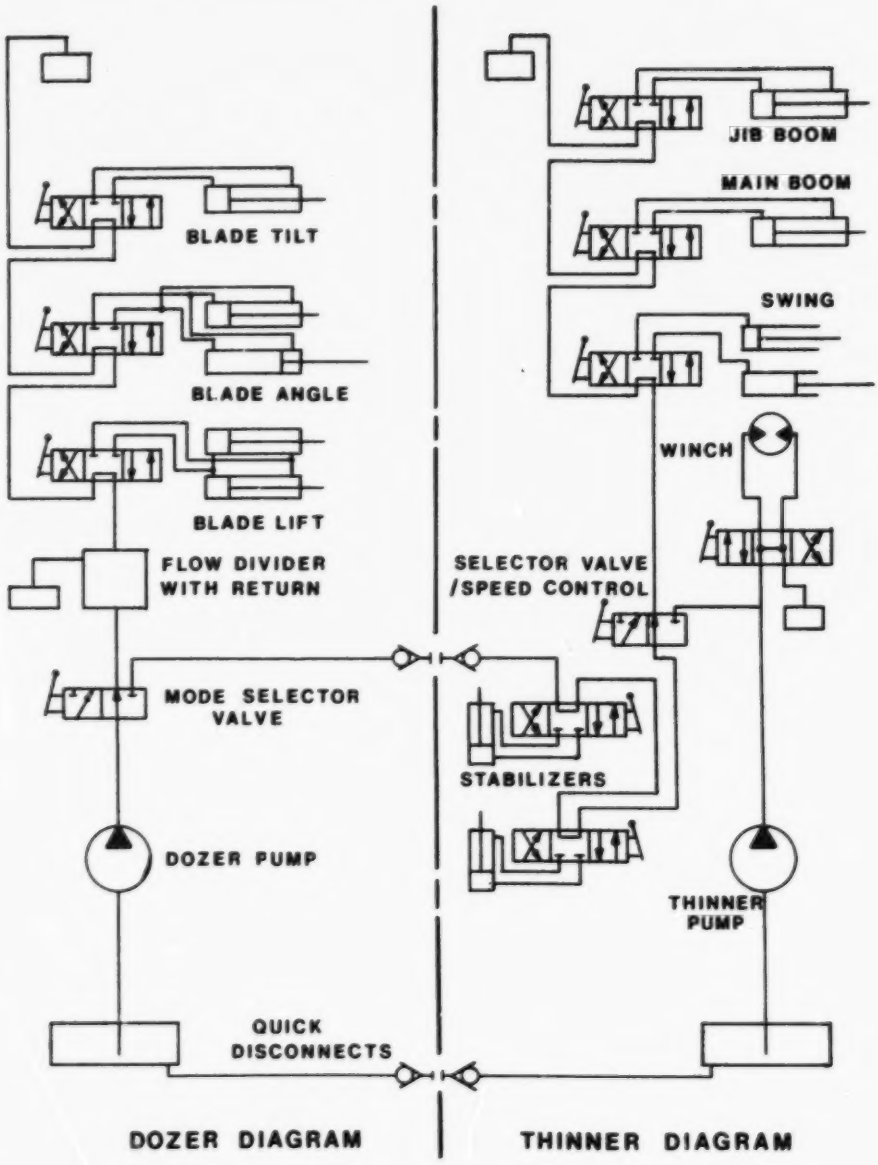
Figure 11.—Hydraulic circuit diagram.



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